

RADIO
WARNING
STUDIES

420933

September 1965



Prepared for:

OFFICE OF CIVIL DEFENSE
DEPARTMENT OF THE ARMY
WASHINGTON, D.C. 20301

RADIO
WARNING
STUDIES

RADIO WARNING SYSTEM INTERFACE STUDY

By:

Dan G. Haney, David A. Curry
and Albert E. Moon

September 1965

SRI Project No. MU-5071
Contract No. OCD-PS-64-233

STANFORD
RESEARCH
INSTITUTE



MENLO PARK
CALIFORNIA

Prepared for:

OFFICE OF CIVIL DEFENSE
DEPARTMENT OF THE ARMY
WASHINGTON, D.C. 20301

This report has been reviewed by the Office of Civil Defense and is approved for publication. This approval does not signify that the contents necessarily reflect the views and policies of the Office of Civil Defense or various state and local civil defense organizations.

Although this document does not contain classified information, it has not been approved for open publication by the Department of Defense. Open publication, wholly or in part, is prohibited without prior approval of Stanford Research Institute.

Qualified requestors may secure copies of this report from the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314.

TABLE OF CONTENTS

	Page
LIST OF ILLUSTRATIONS.....	v
LIST OF TABLES.....	v
 I INTRODUCTION	 1
II SUMMARY AND CONCLUSIONS	5
III CIVIL DEFENSE SHELTER PROGRAMS	9
Introduction	9
National Fallout Shelter Program	9
National Fallout Shelter Survey	11
Shelter Development Program	13
Shelters Constructed under Private Initiative	14
Marking and Stocking Fallout Shelters	16
Shelter Manager and Community Shelter Planning	17
Fallout Shelter Interface Analysis	18
Blast Shelter Program	20
Present Status of Blast Shelters	20
Possible Future Developments	20
Blast Shelter Interface Analysis	21
Summary of Shelter Program Interface Analysis	21
IV EMERGENCY OPERATING CENTERS	25
Organization and Responsibilities of Emergency	
Operating Centers	25
Local Warning Dissemination	27
Instructions for Movement to Shelter	28
Public Information during Confinement and Emergence	
Periods	31
Present and Potential Coverage of EOC Program	33
EOC Program Interface with Radio Warning Program	35
V CIVIL DEFENSE COMMUNICATION SYSTEMS	39
Program Description -- Present Status	39
Program Description -- Possible Future Status	42
Limited Improvement	42
Advanced Improvement	44

TABLE OF CONTENTS (Continued)

		Page
	Interface Analysis	46
	National Dissemination of Warning	46
	Local Dissemination of Warning	50
 VI	THE CIVIL DEFENSE WARNING SYSTEM	59
	Federal Warning System -- NAWAS	59
	State and Local Warning Systems	60
	Improvements to NAWAS	61
	Improvements in State and Local Warning Systems	61
	Interface Analysis	62
 VII	PUBLIC INFORMATION PROGRAMS	65
	Program Description	65
	Technical Information	65
	Information about Civil Defense	66
	News on the Progress of Civil Defense	66
	Effect of Civil Defense Information on Public Attitudes	67
	Interface Analysis	67
 APPENDIX A	THE VITAL ROLE OF EMERGENCY OPERATING CENTERS IN COMMUNITY SURVIVAL	A-1
 APPENDIX B	ANTIBALLISTIC MISSILE PROGRAMS (Classified supplement bound under separate cover)	B-1

LIST OF ILLUSTRATIONS

Figure		Page
1	Civil Defense Information Flows	2
2	OCD Plan for Locating and Developing Fallout Shelter Space	10
3	Comparison of WWVB and NACOM 1 Communications Systems at the National Level	48
4	Comparison of Two Communications Systems at the Local Level.	53

LIST OF TABLES

Number		
1	EOC Program Status	34

FOREWORD

This document has been prepared as partial fulfillment of Contract OCD-PS-64-233 between the Office of Civil Defense and Stanford Research Institute, and is designed for use by the Office of Civil Defense and its contractors in the development of a national radio warning system. It is the final version of a preliminary working paper issued in draft form for OCD review in November 1964. The paper was prepared by Dan Haney, David Curry, and Albert Moon, with cooperation from the following SRI staff members: Richard Condit, Arthur McGee, Victor Preisser, Robert Self, and Sanford Thayer. The guidance and suggestions of Robert Martin and Ralph Sinnott of the Office of Civil Defense are also acknowledged with appreciation.

I INTRODUCTION

The general requirements for a radio warning system have been formulated in sufficient detail in previous studies (Refs. 1 through 5)* to raise several questions about the system.

1. How does a radio warning system fit in with other OCD programs and systems, both in their present configuration and in possible future configurations?
2. What subsystems of the total civil defense effort should be studied in detail for potential interfaces with a radio warning system?
3. Do the results of interface considerations suggest any early guidelines for radio warning system design and configuration studies?

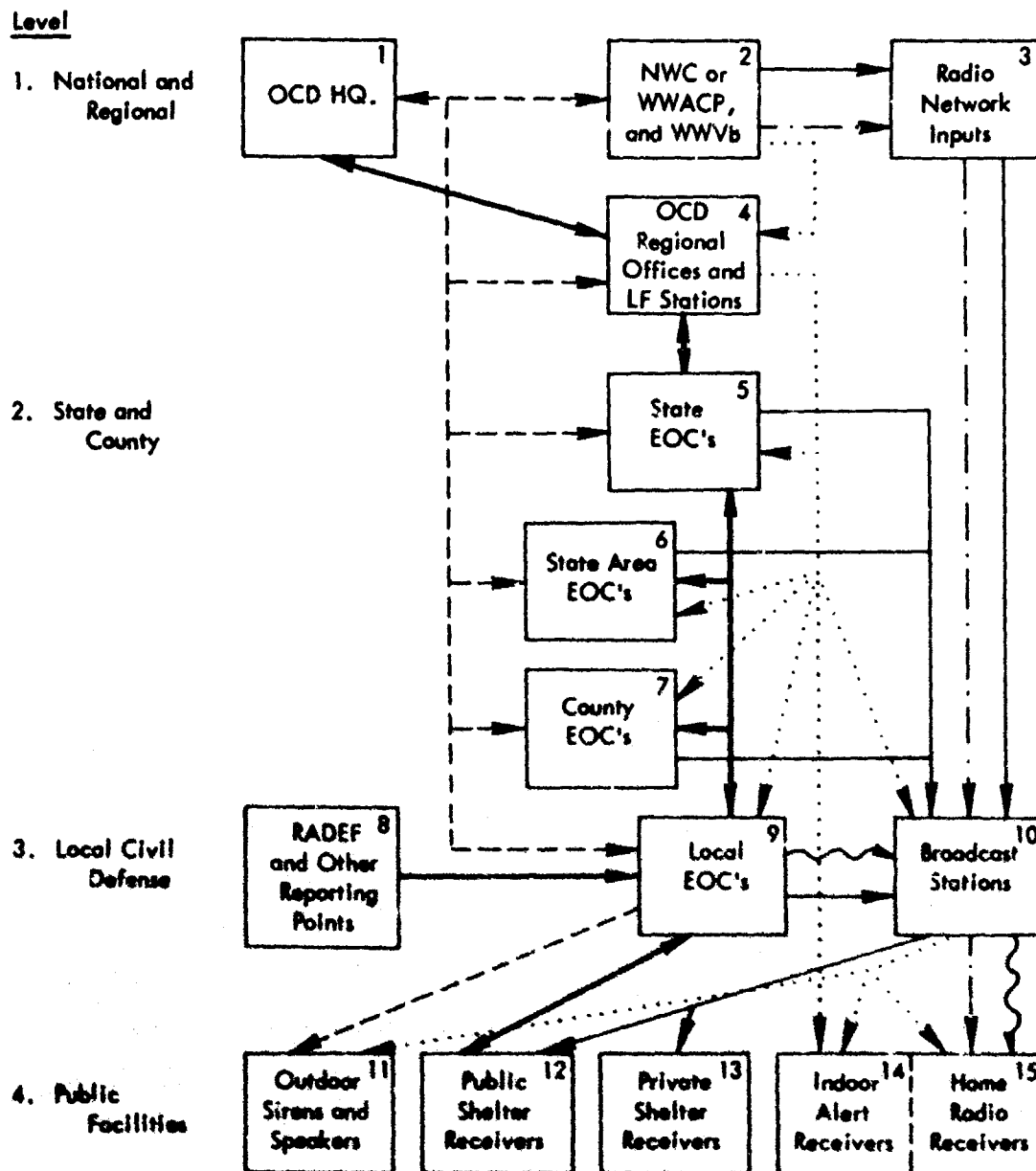
To answer the first two of these questions and prepare for answering the third, the major information flows of the civil defense program need to be considered. Figure 1 portrays the major nodes and links of these information flows as they might appear at some future time. Note that OCD Regional Offices and LF stations (Node 4) might actually be physically separate, as are the National Warning Center, Washington Warning Area Control Point, and the VLF station WWVB (Node 2). Nodes 9 and 12, local EOC's and Public Shelter Receivers, may be separated by intermediate shelter complex headquarters in large cities. Nodes 13 and 14, Indoor Alert Receivers and Home Radio Receivers, have been shown separated by a dashed line to indicate that the two functions will be combined in one device at some or all locations. None of these qualifications affects the usefulness of the diagram for general observations.

The remainder of this paper will be largely a description of the present and potential forms of nodes and links shown on Figure 1, together with analyses of interfaces between them and the radio warning system (symbolized by dotted

*References are listed at the close of each section.

FIGURE 1

CIVIL DEFENSE INFORMATION FLOWS



- Communications: command, control, and intelligence
- - - - - NAWAS-type attack warning system
- Possible configuration of proposed radio warning system
- . - . - Emergency action notifications
- ~~~~~ Public Instructions for movement to shelter
- ===== Public Information during confinement and emergence stages

lines on Figure 1). Section III describes the civil defense shelter program (Nodes 12 and 13). Section IV describes the EOC program, with emphasis on the local EOC's (Node 9) and their links with broadcast stations (Node 10) and public facilities (Nodes 11 and 12). Section V discusses civil defense communications systems (symbolized by the heavy solid lines on Figure 1), together with advantages and disadvantages of two illustrative communication and radio warning system configurations. Section VI considers the NAWAS type of attack warning system (dashed lines on Figure 1). Finally, two programs not shown on Figure 1 are described: public information (section VII) and the antiballistic missile program (Appendix B, a classified supplement bound separately).

The foregoing interface programs should give a reasonably complete picture of the total civil defense effort as it affects requirements for a radio warning system. The following classification scheme (similar to that proposed by SDC in Reference 5) will be used for the purpose of analyzing system requirements:

1. System functions
2. Receiver functions
3. Signal coverage
4. Receiver coverage
5. Structure and operation
6. Response time
7. Reliability
8. Survivability
9. Security and sabotage

The general approach in each section of the paper will be to describe the present and potential scope of an interface program; significant proposals from recent and current research on the program; characteristics or features on which the effectiveness of the program hinges during an attack, with emphasis on any interactions with the radio warning system; and design guidelines or

implications of the program for the radio warning system. It is not the objective of the interface study to specify total radio warning system requirements, but to identify any refinements, amplifications, or changes of present requirements that appear necessary to consider or to study due to the anticipated interaction of the radio warning system with other civil defense programs.

REFERENCES

1. Civil Defense Warning Requirements Study, Systems Development Corporation, TM(L)-900/001/01, January 1963.
2. Minutes of the July 6-9, 1964, Meeting of the OCD Working Group for Radio Warning.
3. Radio Warning System Requirements, System Development Corporation, Draft Paper, TM(L)-1960/021/00, September 24, 1964.
4. Minutes of the September 29-30, 1964, Meeting of the OCD Working Group for Radio Warning.
5. Radio Warning System Interim Operational Requirements, System Development Corporation, TM-L-1960/021/02, February 1, 1965.

II SUMMARY AND CONCLUSIONS

This analysis confirms the obvious fact that the lifesaving potential of a radio warning system is heavily dependent on the adequacy of such complementary civil defense programs as availability of prepared fallout or blast shelters, the readiness of local civil defense organizations, the effectiveness and survivability of civil defense communications networks, the coverage and reaction time of other attack warning systems, and the extent of public education for civil defense emergencies. A numerical evaluation of possible trade-offs between these other programs and a radio warning system was not possible within the scope of this study. However, some important relationships are clear, and these are summarized in the conclusions listed below. *

1. A tentative maximum response time of four minutes is suggested for a radio warning system, but this objective should be reduced to one minute or less if and when a public blast shelter program is implemented. The initial public receivers should be designed to be compatible with the ultimate system requirement of one minute, since, once a large number of receivers are in the hands of the public, these receivers will be difficult and expensive to modify. In the interest of short system reaction time, dual tones for the receiver control signal are recommended as a means of reducing the risk of receiver falsing, in preference to single tones with time delays. (See Section III).
2. A deficiency of prepared shelter spaces in no way reduces the desirability for complete radio warning signal coverage. An early warning will still help to save lives if followed promptly by locally originated

*For convenience in relating these conclusions to system requirements, it is noted that conclusion 1 concerns response time; 2 concerns signal coverage; 3 concerns survivability; 4 concerns system functions; 5, 6, 7, 8 and 10 concern structure and operation; and 9 concerns both system functions and receiver functions.

instructions directing the public to whatever prepared shelters do exist, as well as to unprepared shelters (See Section III).

3. Transmission of attack alert signals and warning messages to fallout shelters during the confinement period does not appear to be absolutely necessary. Blast shelters may present a different problem due to the need to close the air vents to shelters against attacks during the confinement period. (See Section III.)
4. This study of civil defense interface programs confirms the need for locally originated radio instructions to the public, both during the movement-to-shelter period and during the confinement period. However, it was not determined that the same system should perform both the national attack warning functions and the public instruction function. The final determination of whether these functions should be combined must come from other studies, including (a) the feasibility of closely coupling separate systems for national attack warning and for public instructions and (b) the economics of separate vs combined functions. (See Sections III, IV, and V.)
5. The possible need for higher-level EOC's to assume local control in the event of destruction of local EOC's makes it essential for county, state area, and state EOC's to plan for inputs to the radio warning system or EBS, whichever is the source of public instructions during the movement-to-shelter and confinement periods. (See Section IV).
6. In the event that separate radio channels are used for national attack warnings and for the detailed public instructions which follow, attention should be given to the uses of the attack warning channel after the initial warning. For example, the attack warning channel could be used to broadcast information of more general usefulness at the same time that the other channel is being used for local instructions (See Sections IV and V).

7. Several components of present or potential OCD communications systems, such as NACOM I, should be seriously considered as links in a radio warning system, on the basis of reliability, survivability, re-constitutability and cost. Even if these components are not used as primary links in the radio warning system, their potential as backup links and for verification of receipt of warning needs to be considered in the design of the system. (See Section V.)
8. The procedures and hardware for initiation of attack warnings and EAN's at the National Warning Center should be designed to issue a single message rather than separate messages, for NAWAS, the EBS, and a radio warning system. (See Section VI.)
9. The design of a radio warning system should not be based on the expectation that public awareness and understanding of civil defense emergency plans will ever be high or widespread (see Section VII). Among other things, this conclusion affects the need for close coupling of the attack warning message and the detailed public instructions that follow it. Furthermore, the demand for receivers by the public may be expected to be low, except at very low prices (on the order of \$1.00 to \$3.00). This latter problem may affect receiver design or receiver distribution plans, or both, and will be elaborated on in a separate SRI working paper.
10. The design of the radio warning system should be flexible enough to allow future provisions for impact warning inputs from ABM batteries, if approval of Nike-X or some similar system (together with a blast shelter program) ever appears likely. This requirement could affect the design of both transmitter and receiver hardware. (See classified supplement on antiballistic missile programs.)

III CIVIL DEFENSE SHELTER PROGRAMS

Introduction

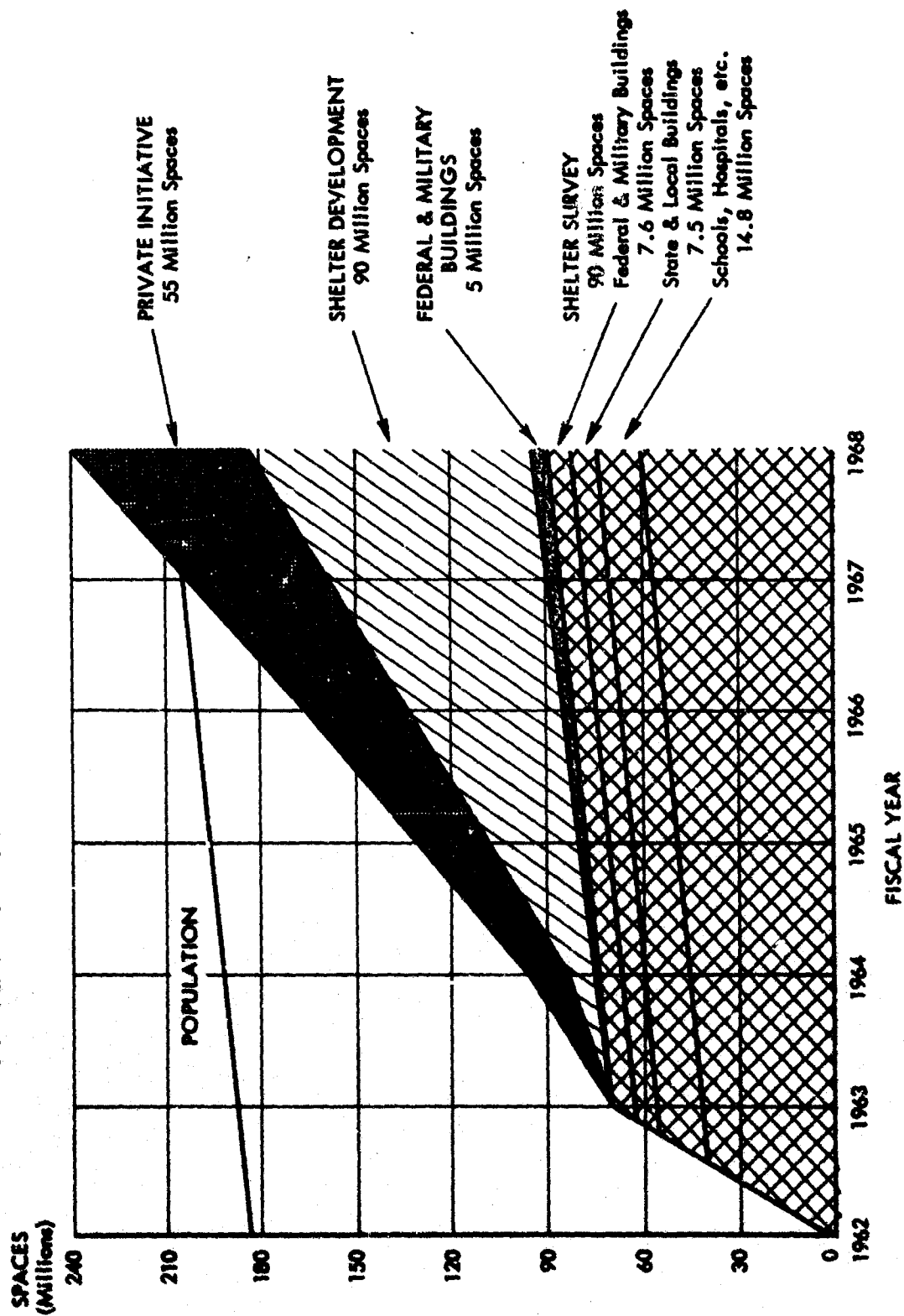
In this analysis of the effects of the shelter interface program upon radio warning system requirements, several levels of shelter effort are considered: (1) the present fallout shelter survey program, (2) the proposed fallout shelter development program, (3) the program to encourage fallout shelter by private initiative and (4) blast shelter programs. Each program will be examined for its effects upon radio warning system requirements and finally, to make sure that all of the possible effects are found, a detailed review of each category of radio warning system requirements will be made.

National Fallout Shelter Program

As part of an overall civil defense program proposed by President Kennedy in 1961, a program was launched in 1962 to locate or develop fallout shelter space and mark and stock it to provide fallout protection for the entire population. (Ref. 1, p. 3.) This program, sometimes called the full fallout shelter program, would result in about 240 million spaces to shelter the estimated 1970 population of 210 million persons, with provision for day-night differences in local population. Figure 2 shows the OCD plan for locating and developing spaces. The three principal sources of shelter shown in Figure 2 -- the National Fallout Shelter Survey, the Shelter Development Program, and shelter developed under private initiative -- are briefly described in the following paragraphs. A description of the shelter marking and stocking process and comments on two supporting programs, shelter management and community shelter planning, are also included.

FIGURE 2

OCD PLAN FOR LOCATING AND DEVELOPING FALLOUT SHELTER SPACES



SOURCE: Highlights of the U.S. Civil Defense Program (Ref. 18) and Census Data.

National Fallout Shelter Survey

The 1963 Annual Report of the Office of Civil Defense describes the Fallout Shelter Survey as follows (Ref. 1, pp. 19-22):

"The initial shelter survey was completed in fiscal year 1963. Using procedures and techniques developed and specified by OCD, the Army Corps of Engineers and the Navy Bureau of Yards and Docks contracted with architect-engineer firms to make the survey and supervise the work in two phases.

"Phase I operations primarily identified potential fallout shelter areas in all public and private buildings, excluding single-family dwellings, having a fallout protection factor of 20 or higher, and a potential capacity for at least 50 persons. Contractors analyzed day and night population data, determined potential public fallout shelters in assigned geographical areas, and collected structural data for machine computation of protection factors of buildings. Only structural data on shielding, not data on fitness for occupancy or modification, were sought.

"Phase II operations made a detailed onsite survey of buildings identified in Phase I as having a protection factor of 40 or higher and being suitable for fallout shelter. It devised means and made cost estimates for increasing the capacity of all structures and for improving the shelter protection of buildings having less than a 100 fallout protection factor. Phase II also included the survey of selected special facilities, such as caves, mines, and tunnels, for shelter suitability. Principal improvements considered were additional shielding to increase amount of protection and ventilation to improve habitability and increase shelter capacity."

"Usable shelter space was located in more than 125,000 facilities... having a protection factor of 40 or higher and a capacity to accommodate

a minimum of 50 persons. Shelter space for more than 2 million additional persons was found in facilities too small to meet the 50-person accommodation requirement.

"The principal result of this operation was the location of shelter space for approximately 104 million persons... . This inventory will be adjusted as certain facilities are resurveyed and added in areas where there is a deficiency and as shelter space in excess of requirements in other areas is deducted. It is estimated that the final result of these adjustments will show a nationwide total of 104 million usable shelter spaces. Of this inventory, it is expected that space for 70 million persons can be marked, licensed, and stocked."

"Other important results included the following facts and conclusions:

1. Acceptable fallout shelter is available in practically all of the 765 places having more than 25,000 population and in 60 percent of the 2,528 smaller urban centers having more than 5,000 population.
2. Approximately 12 million of the acceptable fallout shelter spaces located are in special facilities.
3. Acceptable fallout shelter space with a protection factor of 40 or higher could be developed for an additional 62.6 million persons by improving ventilation, and 50 percent of this space is located where additional shelter space is needed.
4. Included in the additional acceptable shelter space that could be developed by improving ventilation is space for approximately 16.4 million persons which is located in facilities owned by nonprofit and non-Federal health, education, or welfare institutions and by State or local governments; i. e., 11.2 million in institutional facilities and 5.2 million in State and local government facilities.

"Updating operations. - Following completion of the initial fallout shelter survey, Phases I and II, OCD, in May 1963, established systematic procedures for keeping the results of the survey current and for making effective use of the data . . .

"This operation will provide for a continuing fallout shelter survey on a limited scale, as needed. But priority will be given to areas where shelter deficiencies exist."

By May 1965, 136 million spaces with a protection factor of 40 or more in shelters with a capacity of over 50 persons had been located by the shelter survey and its continuing operations. Of the 136 million spaces that have been located, only 76 million have been obtained for shelter through licensing agreements with the owners (Ref. 2.).

Since the shelter survey program was not expected to, and will not, provide the 240 million spaces estimated to be required by 1968, two other sources of shelter are seen -- shelter development with federal funds and shelters constructed under private initiative. The program for developing shelters with federal funds is called the shelter development program and will be described in the next few paragraphs. The program to encourage private development of fallout shelters will be described in the next subsection.

Shelter Development Program

The objective of the shelter development program is not only to provide additional numbers of spaces but also to improve the distribution of shelters, particularly in suburban areas. Additional spaces are to be made available by providing shelter in federal buildings and by allocating federal funds to (a) provide for ventilation of structures that would be suitable for shelters, (b) assist in the addition of structural modification, primarily shielding, to make buildings suitable for shelters, and (c) assist in the inclusion of fallout shelter in new buildings (Ref. 3, p. 3101.). Structures

suitable for ventilation and modification have been located by the shelter survey. To provide for a wider dispersal of shelter spaces, it is hoped that public schools and hospitals will take advantage of the federal assistance funds. Organizations eligible for federal assistance have therefore been limited to agencies of state and local governments, and private nonprofit institutions.

Legislation to allow the use of federal funds for modifying buildings to include shelters and providing fallout shelters in new buildings was introduced in mid-1963 and was passed by the House of Representatives in September 1963. The Senate has not taken action on the measure. Further, the Civil Defense appropriation bill for 1965 specifically prohibited the use of funds for construction of fallout shelters.

Shelters Constructed Under Private Initiative

To complete the location and development of 240 million spaces, OCD is relying upon private business and individuals to provide 50 million to 55 million spaces without federal funds. (Ref. 4, p. 1585.) Interest in private shelter construction is expected to be stimulated by the fallout shelter survey and the shelter development program. Added impetus to private shelter development is sought through information and educational programs, some of which are listed below.

1. Identification of existing fallout protection in smaller structures.

To locate potential shelter space in private family basements and in smaller multifamily dwellings, a program using the techniques of computer analysis, developed for the national fallout shelter survey, will be used. Householders and building owners will be requested to enter data for the structure on a postcard and return it to OCD. A data processing center will read and analyze the data

in the card and print out the protection factor. The card will be returned to the owner with a statement of the protection factor afforded by his shelter. (Ref. 4, p. 1589.)

2. Development of designs for family shelters. OCD has evaluated plans for low-cost family shelters and published booklets of these plans. State agricultural and mechanical colleges have constructed model shelters. (Ref. 1, p. 39.)
3. Training of architects and engineers in shelter techniques. Recognizing that the architects and engineers will have an influential role in the planning of new construction, OCD has taken steps to further the professional training of these individuals in the techniques of protection against the effects of nuclear weapons. College-level courses and local training programs have been set up. (Ref. 1, pp. 41-44.)
4. FHA incentives. FHA has cooperated with OCD in financing and setting standards for home shelter construction. (Ref. 5, pp. 45-46.)
5. Industrial civil defense efforts. As part of the total industrial civil defense effort, businesses are encouraged to provide shelter for their own employees. (Ref. 1, p. 95.)

Little information is available on the number of private shelter spaces available today. It was estimated in 1962 that about 1 million private shelter spaces existed, (Ref. 5, p. 45) but definitive data will not be available until completion of the program to identify fallout protection in smaller structures. Funds for this program have been requested for FY 1965, but the program is not yet under way. One half million spaces had been provided by business and industry at their own expense as of April 1964. (Ref. 4, p. 1510.)

Marking and Stocking Fallout Shelters

Shelters located by the national shelter survey or developed by the development program will be marked and stocked at federal expense. Those shelters developed with private funds that will not be available for public use or do not meet the requirements for licensing (i. e. , at least 50-person capacity), will not be stocked at federal expense. A prerequisite to marking is the signing of a license agreement with the building owner. The 1963 Annual Report describes the licensing procedure as follows. (Ref. 1, pp. 23-24.)

"Shelter license agreement. - An important continuing action of the shelter survey is the signing of license agreements by building owners to permit the use of acceptable shelter space by the public. Local governments are responsible for obtaining these agreements.

"A special Government form, Fallout Shelter License or Privilege, when signed by the property owner, authorizes: (1) Temporary access by the public to specified shelter space in emergencies, (2) posting and maintenance of shelter signs, (3) maintenance of shelter supplies and equipment on the premises, and (4) Federal and local government inspection. Public use of the shelter is specified as being 'for the sole purpose of temporarily sheltering persons during and after any and every actual or impending attack.' Public access for testing purposes is not granted and, if desired, would have to be separately agreed upon by the owner and local government.

"The agreement entails no monetary payment to or by the owner. He may revoke the license unilaterally by sending a 90-day written notice by registered mail to the appropriate local government agency and to the Office of Civil Defense regional office."

OCD will stock only those shelters covered by such written agreements. Shelters for which license agreements have been obtained are marked with signs

provided by the federal government. These bear the civil defense emblem and the words "fallout shelter" and give the rated capacity of the shelter.

After license agreements are obtained and the shelter is marked, sufficient supplies are placed in the shelter to sustain the occupants for an estimated two-week stay. Federally furnished supplies include (Ref. 6):

1. Food
2. Water containers
3. Sanitation kits
4. Medical kits
5. Radiation kits

Local agencies are encouraged to stock shelters with supplemental supplies and equipment such as emergency lighting devices, AM radio receiving equipment with batteries, telephone jacks where telephones are not available, clothing, bedding, furniture, greater variety and quantity of food, books, recreational materials and additional supplies of sanitary items, medicines, and water. These supplemental supplies are not furnished by the Office of Civil Defense, but under certain conditions may be eligible for purchase under the contributions program. (Ref. 7, p. 2.)

As of July 25, 1965, over 76 million spaces had been marked, of which over 34 million had been stocked. (Ref. 2.)

Shelter Manager and Community Shelter Planning

While almost every civil defense program might be considered to be a shelter supporting program, as are many of the interface programs described in this study, it will be of interest to mention two programs which may be expected to have some effect on the interface between shelters and radio warning. These supporting programs are the programs to select and train shelter managers and the program for community shelter planning.

The shelter manager is the individual who will be in charge of the shelter during the confinement period. Training programs have been set up to train individuals for this function.

The objectives of community shelter planning are to devise an optimum assignment of persons to shelter spaces, considering the probable threat to the community, population, location, existing shelter location and physical features of the city and to determine the most effective locations for shelters added under the shelter development program. A program is currently under study to implement community shelter planning on a nationwide level. Part of the program is a pilot training course to enable community planners to do the planning. Based on the experience of the pilot program, training materials will be prepared and instructors will be trained. These instructors will, in turn, conduct a widespread training program for community planners.

Fallout Shelter Interface Analysis

The shelter deficit suggested by Figure 2 may extend into the 1970's due to the delay in starting the shelter development program. Even if the 240 million spaces are marked and stocked, some persons will not be able to use these shelters because they are too far away, or the shelter development has lagged behind the growth of certain areas. However, many opportunities for shelter will exist in places that, for one reason or another, were not marked and stocked. A large fraction of these spaces would be available for use in an emergency. Since these places cannot be included in the announced civil defense plans, local information will have to be provided, at the time of attack, to allow this shelter potential to be utilized and to allow the persons using it to be prepared with supplies.

From this analysis, two conclusions about radio warning are possible: (1) the inadequacy of the shelter coverage does not imply that warning coverage should be any less than total and (2) local information and instruction is needed to supplement a general warning of a national attack. This local information and instruction should be coordinated with and closely follow the national attack warning, but need not be delivered over the same system as the national warning.

Those persons using shelters that have not been marked and stocked and some persons in home shelters will be faced with serious shortages of food and water and will be living in very primitive conditions. Shelter management and radiation kits will not be available. For these people, information on radiation levels, safe exit times, location of uncontaminated food and water supplies, and general survival information must be transmitted to the shelters by radio. Again, this information need not be transmitted by the system that announces the national attack.

There does not seem to be a convincing need for delivering alert signals and announcements of further national attacks to the fallout shelters. In most cases, occupants of fallout shelters will not be able to improve their situation without risking heavy radiation doses. Information of the type described in the two preceding paragraphs is much more vital and, if a move is being considered, would provide realistic data for evaluating the possible consequences of a move. This analysis leads to two related conclusions: (1) the device for receiving the alert and national warning message need not be carried to the shelter if another radio is available and hence does not need to be portable; and (2) outages can be tolerated in parts of the system when the people served by those parts are in shelter. However, any time the population is not in shelter, alert and warning capability is necessary.

Blast Shelter Program

In the event of a nuclear war, many more people in the United States would survive if they were protected from the blast effects of nuclear weapons as well as from fallout. There are, however, a number of problems which arise in providing blast protection. Among these are: (1) the relatively high cost of constructing a blast-resistant structure and (2) getting people into the shelters in the very short time between a tactical warning of attack and the arrival of the blast effects. Moving people into blast shelters involves not only providing a very rapid warning -- a potential which a radio warning system has -- but also locating shelters where they are rapidly accessible and training the population to react quickly enough to reach the shelters.

Present Status of Blast Shelters

Because of these problems and because the Office of Civil Defense is devoting a large portion of its time and money to the National Fallout Shelter Program, to systems that support the fallout shelter program, and to improvements in fallout shelters, there are no public blast shelters, as such, in the United States, and there is no program to provide them. There are, however, some fallout shelters that will provide a limited degree of blast protection, and the shelter survey is accumulating data on these structures. At the present time, OCD research groups and OCD contractors are studying components of blast shelters, costs of blast shelter construction, and cost effectiveness of blast shelters.

Possible Future Developments

The likelihood that a blast shelter program will be implemented depends not only on the solution of the problems of getting people into shelter but also on future states of international tensions, results of ABM studies, and the relationship between ABM protection and blast protection for civilians. Finally, the

implementation of a national radio warning system might demonstrate the capability for rapid warning necessary for blast sheltering and thus spur the blast shelter program.

Blast Shelter Interface Analysis

The primary effect of the implementation of a blast shelter program upon radio warning requirements would be the requirement for a very rapid system response time. The need for a system to deliver a tactical warning is assumed, because (1) tactical warning allows the population to engage in productive activity for a longer period of time, (2) a surprise attack not preceded by a strategic buildup might occur, and (3) the provocative nature of strategic sheltering might limit its usefulness.

The second effect on radio warning requirements would be the requirement for transmitting alert and warning signals into shelters. Subsequent attacks would require that the shelters be "buttoned up" (close blast valves and ventilating openings) in anticipation of further blast waves. The occupants need be alerted and warned to perform the "buttoning up" process.

Summary of Shelter Program Interface Analysis

In this concluding portion of the shelter program interface analysis, the results of the previous analysis of fallout and blast shelter interface analysis will be summarized. Each item of the radio warning requirements will be listed and discussed to ensure that the interface analysis is complete.

1. **System functions.** The present analysis of the shelter interface program has shown the need for the broadcast of local instructions and information, both before and during the period of shelter occupancy. This function of providing information and instruction would, under current planning, be performed by the EBS stations, which would be equipped to broadcast messages from the local EOC. Whether or not this function

is integrated with the radio warning system should depend upon its compatibility with other requirements and the relative costs of providing integrated or separate facilities.

2. Receiver functions. See comments on response time.
3. Signal coverage. The potential use of unprepared shelter makes it desirable to warn everyone whether or not they have access to a prepared shelter.
4. Receiver coverage. Same comment as for Signal coverage.
5. Structure and operation. Study of the shelter interface program does not indicate change in requirements.
6. Response time. The distribution of fallout shelters among the population is now -- and can be expected to continue for some time -- such that many people near locations of nuclear explosions will not be able to reach shelters before fallout arrives. This means that reductions in warning time can have positive effectiveness, but such reductions must be evaluated on a cost-effectiveness basis.

For blast sheltering, a system response time goal of less than one minute is proposed, using an average tactical warning time of ten minutes and a rule of thumb that the warning system should not consume more than 10 percent of the time available to take action. Using the same rule of thumb and an additional 30 minutes for first fallout arrival, a required time of less than four minutes is estimated for warning a population that has fallout protection.

Since the implementation of the blast shelter program is quite uncertain, it is recommended that the four-minute figure, based on a fallout shelter program, be used as the present system response time requirement. However, blast shelters must be considered as a growth potential of the shelter program, and, since the receivers, once in the hands of the public, will be difficult and expensive to modify, the receivers should

be designed for compatibility with an ultimate response time of less than one minute. Compatibility with the faster response time implies that multiple tones are to be preferred to time delays as a means of reducing the probability of receiver falsing.

7. Reliability. No modification to requirements is indicated by the shelter interface study.
8. Survivability. The fact that alert and warning are not required in fallout shelters may make postattack outages tolerable for short periods of time, provided, however, that (1) these outages do not occur as a result of the early detonations, which may be the confirmation of attack, (2) the local components of the system which is to broadcast local information and instruction to the public should not be dependent on the central components of the warning system for their operation, and (3) the central components of the warning system can be reconstituted in time to be usable when the population emerges from shelter. Further, the vulnerability of the system which is tolerable under a fallout shelter system will not be acceptable with the implementation of a blast shelter program, so survivability of the central components should be a growth factor if not included originally.
9. Security/sabotage. Study of the shelter interface program does not indicate a change in the requirements for security or the prevention of sabotage.

REFERENCES

1. 1963 Annual Report, Department of Defense, Office of Civil Defense.
2. Selected Statistics on the Fallout Shelter Program, Department of Defense, Office of Civil Defense, Statistical Report 7720.33, July 25, 1965.
3. Civil Defense-Fallout Shelter Program, Hearings before Subcommittee No. 3, Committee on Armed Services, House of Representatives, 88th Congress, 1st Sess., Part 1, May 1963.

4. Independent Offices Appropriations for 1965. Hearings before Subcommittee of the Committee on Appropriations, House of Representatives, 88th Congress, 2d Sess., Part 2, April 1964.
5. National Fallout Shelter Program, Sixteenth Report by the Committee on Government Operations, U. S. Congress, House of Representatives, Report No. 1754, May 1962.
6. Description of Shelter Supplies and Equipment, Federal Civil Defense Guide, Part D, Chapter 2, Appendix 1, March 15, 1963.
7. Provisioning Shelters, Federal Civil Defense Guide, Part D, Chapter 2, September 1964.

IV EMERGENCY OPERATING CENTERS

This section of the interface study describes present and potential programs for emergency operating centers (EOC's), with emphasis on local EOC's, and analyzes the effect of the EOC program on plans for a radio warning system.

Organization and Responsibilities of Emergency Operating Centers

It is evident that essential local government operations, including civil defense functions, would be interrupted over wide areas by the direct effects and aftereffects of a nuclear attack on the United States. The only known way to enhance the possibility of continuity of local governments through a period of nuclear attack is to provide them with protected facilities -- the more protection the better, but fallout protection is a minimum requirement even in non-target areas. To this end, the Office of Civil Defense encourages, and participates in the financing of, local emergency operating centers which provide protected facilities for emergency direction and control of essential local government and civil defense operations. (Ref. 1, p. 22.)

As indicated on Figure 1, the local EOC is linked to successively higher level county, state area, state, and regional EOC's. It should be noted that the responsibilities of EOC's and the relationships between EOC's at different levels are still not firmly defined. The information on these subjects which follows is therefore taken from the tentative results of current research at SRI, under contract to OCD. (Refs. 2, 3.) The basic tasks of EOC's at the county and local levels that are indicated by this research are summarized below:

Local EOC Tasks

1. Disseminate attack warning locally, after receipt of warning via NAWAS.
2. Transmit instructions and information to the public for movement to shelter, confinement, emergence, and recovery phases.
3. Evaluate intelligence: further attack warnings, local blast effects, RADEF, damage assessment, population and resource status reports, etc.
4. Coordinate emergency measures: fire control, rescue, decontamination, medical aid, restoration of facilities, etc.

County EOC Tasks

1. Aid local EOC's to achieve county population survival and recovery.
2. Allocate resources within county and coordinate recovery efforts.
3. Consolidate damage assessment and RADEF information.
4. Restore or temporarily replace inoperative local or state area EOC's.

Tasks of EOC's above the county level are chiefly of the county type: to consolidate damage assessment information, allocate resources between competing needs, coordinate recovery efforts, and assume interim responsibility for other EOC's, where necessary.

The operations of EOC's may be divided conveniently into five periods or phases: preparation, attack, confinement, emergence, and recovery. During the attack, confinement, and emergence periods, local EOC's are expected to have the best information on local hazards and protective facilities, the most direct contact with the public, and consequently the greatest life-saving potential. During the recovery period which follows emergence from shelter, the county and higher level EOC's will assume more important roles in the allocation of food, medical supplies, and other resources to areas of greatest need, and in the coordination of recovery efforts.

The tasks of a local EOC that have the greatest implications for design of a radio warning system are local warning dissemination, public instructions

for movement to shelter, and, to a lesser extent, public information during confinement and emergence. These tasks will be considered in the following subsections. More complete discussions of suggested local EOC responsibilities are presented in Appendix A and Reference 4 (pp. 25-30).

Local Warning Dissemination

The first public responsibility of a local EOC during an attack is prompt dissemination to outdoor sirens and speakers of the initial attack warning. This function is depicted in Figure 1 by the dashed line extending from the Local EOC's node.

If a radio warning system is implemented, the local EOC's responsibility for warning dissemination may be supplemented or replaced by automatic radio control of sirens (this possibility is shown in Figure 1 by the dotted line extending from the Broadcast Station node to the Outdoor Sirens and Speakers node). However, complete replacement of EOC responsibility for local warning dissemination does not seem likely for the following reasons:

1. While it would be technically feasible to control local siren systems automatically by signals, it may be politically impossible in many communities to replace local control. The time delays in the present warning dissemination system can be considerably reduced, and could even approach those of an automated system if (a) the local EOC staff or its equivalent is given the authority to sound sirens rather than vesting authority in the local political leader or leaders and (b) the number of manual relay points in the present warning system is reduced by reliance on radio warning receivers located at the EOC. These improvements might frequently constitute a more acceptable alternative than would complete replacement of local control by an automatic siren control system.

2. In addition to fixed outdoor sirens, it is anticipated that many communities will use sirens or loudspeakers mounted on police cars moving through city and suburban streets to spread the alarm. A system to assume automatic control of police car sirens or loudspeakers seems inherently more difficult both to design and to gain acceptance of than a system for activating fixed sirens.

What appears more probable than widespread or rapid substitution of radio control for EOC control of public sirens is the selective introduction of radio controls for certain siren or alarm systems -- for example, in schools or other institutions that are independent of the public siren system. Whether implementation is gradual or rapid, however, there seems to be a clear case for designing the capability for selectively controlling local siren and alarm systems into the radio warning system.

Instructions for Movement to Shelter

The second public responsibility of local EOC's, following or concurrent with the dissemination of warning, is to transmit detailed instructions for movement to shelter. Vacant shelter spaces and unprepared shelters (such as storm culverts) will be identified, and special instructions will be necessary for persons in transit or otherwise remote from shelter: should they attempt to get to a distant shelter or improvise shelters wherever they find themselves? Instructions for constructing the best shelters that can be devised in a matter of hours (or before the arrival of fallout) should be broadcast, whether by the local EOC or by higher authorities.

Several examples of the types of instructions to be considered during the movement-to-shelter period are given below (Ref. 5, p. 10):

1. Stay where you are; stop all moving vehicles and pull off the road.

2. Stay indoors or move indoors (keep away from windows).
3. Stay outdoors or move outdoors (get away from buildings, trees, and combustibles).
4. Carry out preplanned emergency shutdown procedures (or if these have not been worked out in your area, turn off or close down any operations or utilities you control which may be hazardous to life and property if left unattended or if dislodged by blast forces).
5. Seek the best protection from nuclear weapons effects that can be found in seconds in your immediate vicinity.
6. Go to your assigned (or nearest) shelter. If there is none such take the best cover you can find.
7. "Button up" your shelter promptly.
8. Carry out previously planned emergency evacuation.

Although fixed and police car loudspeakers would be used for brief public instructions, the most widely planned channel for these instructions is over a local EBS station. Preferably, this would be the key National Defense Emergency Authorization (NDEA) station, from which the instructions would be picked up and carried by other nearby NDEA stations.

Several problems concerning the present ability of EBS stations to transmit EOC instructions promptly will be noted next.

Depending on the speed with which the national Emergency Action Notification (EAN) has been disseminated to local EBS stations, the station contacted by the local EOC may or may not have already alerted the listening public to the attack. However, as observed in a recent System Development Corporation report on the EBS (Ref. 6, p. 18):

"If the public can be alerted in a shorter time than is required for the activation of EBS, then EBS activation time must also be reduced. Alerting and warning information must be coincident in timing for greatest effectiveness."

As observed elsewhere in the same report, a sudden attack could also interfere with the receipt of the EAN by the local EBS station, and backup procedures that permit local EOC announcement of the EAN have not yet been developed. Furthermore, inadequate local preparation for conveying warning instructions through EBS stations in many communities is indicated by the following statement (Ref. 6, p. 20):

"The Presidential and national news aspects of EBS programming have been planned and an operational system exists for inputting information on an ongoing basis. The local and state programming areas have fallen behind the needs. Some localities and states have prerecorded messages from government officials to immediately inform their public of the existence of a national emergency and of preventive actions to be taken. Others plan to rely on live broadcasts. However, many localities have no operational plans for informing the public of actions to be taken. Usually only landline programming links are available from protected facilities to a key NDEA station to ensure continued local information in a fallout or damage-fallout environment. The key station is usually interconnected with the area NDEA station transmitters by telephone lines, but plans for using other NDEA stations as alternate key stations are frequently neglected. Plans for specific state programming entries into EBS are far advanced in some Eastern states, but barely begun in other areas. The specifics of local and state programming require a major effort in the near future."

It is evident that the foregoing problems must be remedied if a radio warning system is to be effective, whether the EBS is considered a part of, or separate from, the radio warning system itself.

Public Information during Confinement and Emergence Periods

Persons confined in public shelters ideally would be in touch with local EOC's by survivable, two-way communications, shown in Figure 1 by the heavy link between Local EOC's and Public Shelter Receivers. These communications links, planned and established in standby condition prior to attack, would be used for vital confinement instructions and information. Persons in private shelters would be dependent chiefly on portable AM radios taken to shelter with them, because even if the telephone system survived an attack, the large number of private shelters would make individual communication with EOC's infeasible for the amount of information needed.

The use of AM broadcast stations for one-way postattack communication has been studied recently (Ref. 7), and it may be helpful to list for illustrative purposes the types of potential messages identified, most of which would originate at or pass through the local EOC:

1. Fallout advisories
 - a. Safe exposure time
 - b. Fallout forecasts
 - c. Warning of hot spots
2. Food and water distribution
 - a. Location of food and water
 - b. Decontamination of food and water
 - c. Identification of safe foods
3. Care of sick and wounded
 - a. Location of emergency hospitals
 - b. Emergency first aid instructions
 - c. Location of emergency medical supplies
 - d. Calls for blood donors
 - e. Calls for volunteers to man emergency hospitals

4. News of the attack and counterattack*
5. Warning of another attack*
6. Self-help instructions
 - a. Use of the dosimeter to calculate safe exposure times
 - b. Sanitation
 - c. Shelter management
 - d. Rationing in shelter
 - e. Disposal of dead
7. Morale-boosting speeches and messages
 - a. Speeches by the President*
 - b. Speeches by local leaders
 - c. Speeches by state leaders*
8. Control of fires
 - a. Calls for volunteers for control of fires
 - b. Warning of fires close to shelters
9. Calling national guard to duty*
10. Care of displaced persons
 - a. Location of displaced persons centers
 - b. Reuniting of families
11. Direction of remedial evacuation
12. Instructions to local civil defense forces
13. Relay of civil defense message
14. Directing still-exposed people to shelter
15. Date, time, broadcast schedule

The purpose of the above list of message types is to indicate that a need does exist for locally originated postattack broadcasts. To the extent that local EOC's or similar protected local sources are unable to supply such broadcasts, it will be necessary for county or other higher level sources to attempt

*This information would probably pass directly to broadcast stations from levels above the local EOC.

to supply the information -- though obviously, the farther from the local conditions the information originates, the less useful much of it will be.

Present and Potential Coverage of EOC Program

Since the radio warning system and the shelter program that EOC's are to complement would aim for 100 percent coverage of the population, it is relevant to ask what the present and potential population coverage of EOC's is. A recent count at SRI (Ref. 2) showed that approximately 8 million persons, or about 4 percent of the population, were served by local EOC's at the end of 1963 (including persons living in county seats that were served by a county EOC). Construction of new EOC's is progressing at an increasing rate; however, as of April 1965 the total number for which OCD has matched funds was only 567 (Ref. 1, p. 22). At that time, many of these were still under construction or in the planning stage.

A summary count of the number of EOC's at each level was made by SRI in July 1964, for comparison with the total potential number of EOC's under each of two assumptions:

Potential A

An EOC for every county and urban area with a population of at least 10,000 persons.

Potential B

An EOC for every county and incorporated town or city in the United States.

The results of the foregoing comparison are summarized in Table 1.

Table 1

EOC PROGRAM STATUS

	<u>Number of EOC's</u>			<u>Number Now Existing as a Percentage of:</u>	
	<u>Existing</u>	<u>Potential A^a</u>	<u>Potential B^b</u>	<u>A</u>	<u>B</u>
State	34	50	50	68%	68%
State area	25	271	271	9.2	9.2
County	173	2,204	3,076	7.8	5.6
Local	123	1,899	19,790	6.5	0.6
Total	355	4,424	23,189	8.0	1.5

- a. Potential A is based on having EOC's in every county and community of at least 10,000 population.
- b. Potential B is based on having EOC's in every county and incorporated community.

Source: Stanford Research Institute.

The small percentages of potential EOC's at the state area level and below -- less than 10 percent of either potential program -- speak for themselves. There is considerable documentation of the difficulties involved in effectively implementing local civil defense measures (Refs. 8, 9), and it has been estimated that some \$250 million would be required to achieve "Potential B" on Table 1 over a period of about five years.* However, there is no current OCD goal for making up the total deficit in EOC's; therefore, it cannot be predicted if or how fast such a program will in fact be implemented.

*Preliminary SRI estimate, under OCD-OS-63-149.

EOC Program Interface with Radio Warning Program

Analysis of the EOC program reveals only a few implications for radio warning system requirements, chiefly of a rather general nature:

1. It has been suggested that the role of the local EOC is to increase the ultimate effectiveness of nuclear attack warning in saving lives, whether the initial public notification comes over automatic radio alerting receivers, by outdoor sirens, or by some other means. The radio warning and EOC programs are therefore complementary. With the present small numbers of local EOC's, however, little confidence can be placed in the ability of local civil defense authorities to follow up the initial warning with meaningful and uninterrupted instructions to the population. This situation, if continued, will substantially diminish the effectiveness of a radio warning system, especially with the relatively untrained population that now exists.

There appears to be no easy alternative solution to this problem -- such as planning for detailed instructions to be broadcast from higher county, state area, or state levels -- because only a local, well-informed civil defense organization will have much of the information that is needed during the movement-to-shelter and confinement periods.

2. A closely related conclusion is the need to plan in advance for the exact content of instructions that will be broadcast from different levels of the radio warning system. For example, it might be useful to broadcast pretaped national or regional instructions for improvising shelters over one network at the same time that other local broadcasts were transmitting instructions for reaching available shelters.
3. Finally, it is evident that the prompt availability of radio and other broadcasting stations for use by EOC's is vital to the success of their communication with the public, following an attack warning, (though

it does not appear to matter whether these stations are conceived of as part of an integrated radio warning network or as part of a separate EBS network). This public instruction function is sufficiently essential that an EOC should preplan means to communicate with any surviving local broadcast station -- especially with those stations that are equipped with fallout protection and emergency generators and preferably are also located in areas expected to be free from direct blast effects. Broadcast links with local EOC's should be of first priority, but higher level EOC's will also need links with broadcast stations both as backup to local EOC's and occasionally for their own program inputs.

REFERENCES

1. Civil Defense 1965, Department of Defense, Office of Civil Defense Document MP-30, April 1965.
2. Planning and Operating Analyses of Emergency Operation Centers, a current SRI project with OCD under Contract No. OCD-OS-63-149.
3. Integrated Information System Studies, a current SRI project with OCD under Contract No. OCD-PS-64-248.
4. Cannell, Rogers, Local Civil Defense System, Stanford Research Institute, Menlo Park, California, October 1964.
5. Condit, Richard L., Concerning the Interface between Civil Defense Warning and Shelter Systems, Stanford Research Institute, September 1964.
6. Special Report for the Office of Civil Defense: The Emergency Broadcast System (EBS), System Development Corporation, TM(L)-1505/041/00, March 31, 1964.
7. Owens, M., and D. Schimelfenyg, The Civil Defense Role of Radio Broadcasting, Technical Operations Incorporated, Report No. TO-B 62-74, January 7, 1963.

8. Organizing Municipal Governments for Civil Defense, American Municipal Association, October 1963.
9. Harker, R., R. Goen, and K. Moll, A Method for Evaluating Local Civil Defense Effectiveness, Stanford Research Institute, Project IM-4970, October 1964.

V CIVIL DEFENSE COMMUNICATIONS SYSTEMS

This chapter of the report covers some of the interfaces between possible radio warning systems and civil defense communications systems. Whereas some of the other interface areas discussed in this report impose requirements upon the design of the radio warning system, the systems covered in this chapter tend to offer alternative or supplementary capabilities rather than impose requirements.

The discussion of present and future programs that is presented in the next two sections is rather brief -- these programs are described in detail in other documents.* Information is presented here only on those aspects of the programs that are relevant to the development of a radio warning system.

Program Description--Present Status

At the national level, two special systems for communication between civil defense organizations are in use. The National Communications System No. 1 (NACOM 1) is the basic means for transmitting OCD operational communications. The system is specifically designed for speed, flexibility, and continuity of service required in civil defense emergency operations. It consists of a telephone and teletype network comprising one telephone circuit and one teletype circuit that connect OCD national and regional centers and state civil defense offices.

The function of NACOM 1 is to provide the means of communications necessary for coordinating emergency government operations from federal to state levels. It provides the primary communications for civil defense

* See references 1-12

command and control functions, including radiological and damage reporting. Its connections extend to emergency relocation sites of national headquarters of selected federal agencies, and portions of the system have been modified to accommodate data transmission of the National Resource Evaluation Center (NREC). The entire NACOM 1 system is operational full-time daily. (Ref. 1.)

NACOM 1 circuits between OCD national and regional centers are part of a hardware system of the Defense Communications Agency called AUTOVON. AUTOVON is a worldwide, general purpose direct-dialing system, which has nine automatic switching centers located in nontarget areas in the continental United States. Circuits between regions and states are separate from AUTOVON.

NACOM 2 is designed to provide backup emergency communications to NACOM 1. It is a high-frequency radio network for voice and teletype and connects the OEP relocation site in the Washington, D. C. area, OCD regions, and states with one another. Control facilities for stations in this system are located near the same operating positions at the regional headquarters as those for the NACOM 1 facilities. This provides fast routing of messages over either system. Highly trained operators are required at both ends of a link.

By the beginning of 1965, NACOM 2 was operational at the OCD emergency relocation site, all OCD regional offices, in about half of the states, and in Puerto Rico and the Canal Zone.

At the state level, capabilities for achieving adequate civil defense communications vary considerably. In some states, detailed plans have been drawn for civil defense communications, while in others little capability exists. In all states, there is an appreciable potential for civil emergency communications because of the possibility of using communications facilities of such state departments as the highway patrol, forest service, highway department, and fire services for civil defense purposes in emergency situations. One

example of a state with extensive civil defense communications capability is California. California has been divided into a number of areas, and civil defense communications pass between the state headquarters and these areas and between these areas and local governments. A number of links connect the state headquarters with the state area headquarters, including private line telephone and teletype, Western Union private line, and a civil defense radio net. Between the state areas and local headquarters, regular telephones, RACES, or a local government radio service net can be used. (Ref. 2.)

Capabilities for civil defense communications also vary at the local level. Land line communications used for local communications are generally limited to commercial telephone. Radio services that may be used for civil defense-related communications include city and/or county fire and police, county road maintenance, county communications, and RACES. At present, communications with public fallout shelters are almost universally limited to commercial telephone.*

Another system of communications for addressing the public has recently been developed. This system is called the Emergency Broadcast System (EBS), and is designed to provide capability for presidential, state, local, and national broadcasting to the public. The EBS consists of radio broadcast networks, the facilities of the Associated Press and United Press International, broadcasting stations, and public radio receivers. EOC's or local government input sources are called for in EBS plans. These links are normally telephone lines, although sometimes direct inputs over a broadcast station's remote frequency are possible.

* Santa Clara County, California, has facilities similar to those described, see Ref. 3.

Although the EBS system is still in the formative stage, a number of problems have been recognized concerning the system's postattack capability. First, the capability for national use of the system may be severely degraded because of damage to the telephone system that carries messages on the radio broadcast networks. Second, although OCD has established a program to provide fallout protection and emergency power for the AM stations in EBS, many of these stations have transmitters and/or studios that are located in probable target areas and may be destroyed if the area is attacked, and thus could not be used to broadcast to persons who may survive the blast effects.

Program Description--Possible Future Status

In considering the projected capability of civil defense communication as of 1970, two levels of communications capability are discussed -- limited improvement and advanced improvement. In general, the limited improvement case is based upon the assumption that no major change in the national shelter posture will have taken place by 1970, while the advanced improvement case is based upon the assumption that the United States will have undertaken a major program of construction of fallout and/or blast shelters by that time.

Limited Improvement

Present planning for the AUTOVON system indicates that a substantial capability for national communications by landline will exist by about 1967. Plans as of November 1964 provided for an increase in the number of switching centers from 10 to 56 by 1967 (Ref. 13). At each regional headquarters, approximately 11 lines of AUTOVON will be available (for use of all federal agencies at the regional headquarters). OCD will have an emergency preempt capability, with a high priority, for NACOM 1 communications. In addition, state headquarters will be connected to AUTOVON, with lines to at least two switching centers each.

By 1970, the AUTOVON system will have been incorporated into the National Communications System, which will also include a number of other military and civilian communications systems. Thus, under one system, a highly redundant and survivable method of telephone and teletype communications will exist.

Even with only limited improvement in communications capability at the national level, it is probable that by 1970 NACOM 2 facilities will be installed in all states and that this system, in addition to NACOM 1, will be available for emergency communications 24 hours a day.

It is safe to predict that a number of state and local governments will have made considerable progress in arranging for civil defense use of the communications capabilities of other government agencies and in establishing additional communications facilities exclusively programmed for civil defense. The existing federal assistance programs ensure some advancement. However, without additional national emphasis on civil defense and increased federal assistance, it is clear that there may be many communities that will not have the capability for immediate communications between different civil defense agencies at different levels of government.

At present, it is planned that fallout protection, emergency power, and radio links will be provided for some 650 AM and colocated AM/FM stations. On this basis, it is likely that coverage will be provided for all but the most sparsely populated portions of the country. In addition, most local EOC's and local governments without EOC's will have provided a full-time communications link with local EBS stations assigned for their area.

Other than EBS, there will be little improvement in the capability to communicate with fallout shelters.

Advanced Improvement

Should a large-scale shelter program be undertaken by the United States, significant improvements in various support systems, including communications, would have to be made to realize the maximum effectiveness of the program.

At the national level, three systems that affect civil defense might offer increased capability for general communications. These systems are for radiological reporting, nuclear detonation reporting, and damage assessment reporting.

An advanced radiological reporting system would probably be composed partly of automatic and partly of manually operated stations. Such a system would probably comprise thousands of stations and would require coordinated communications for data collection and analysis at state, regional, and national levels. Present communications systems are more than adequate for transmission of all foreseeable radiological data reports. Thus, development of an advanced radiological monitoring system would probably not result in the development of additional communications facilities that could be viewed as a capability for satisfying other civil defense communications requirements. (Ref. 6.)

Systems for reporting nuclear detonations may be highly advanced by 1975. Present planning envisions a relatively small number of special stations deployed throughout the United States to detect location, yield, and height of burst of nuclear detonations. The reporting system that would be associated with these sensors requires high-speed communications, and therefore a special purpose communications system. It is doubtful that this nuclear detonation detection and reporting system would have any capability to augment other civil defense communications systems. (Ref. 7.)

Should this system not be implemented, it is possible that less complicated systems may be installed for nuclear detonation reporting. Such a system, however, cannot be foreseen with any degree of certainty, and therefore its potential use for warning dissemination cannot be assessed.

An advanced system for reporting physical damage and population survivors could be installed to serve postattack planning at state, regional, and national command points. While little formal attention has been given to study of such a system, rudimentary consideration of the extent of resources that might be reported upon leads to the conclusion that the required communications facilities might be extensive. Nevertheless, without more planning data, it is not possible to claim either that a special-purpose system will be developed or that such a system could provide additional communications capability for other types of civil defense communications.

The facilities for NACOM 1 and NACOM 2 in 1970 will probably be the same as described in the previous section. Furthermore, it is conceivable that additional national civil defense communications facilities will exist. However, at present, no data are available for establishing the requirements for communications between national, regional, and state agencies, and therefore it is not possible to state that any additional augmentation, over that described earlier, of NACOM 1 and NACOM 2 facilities will have taken place by 1975.

At the state and local level, an advanced shelter program would quite likely result in a marked improvement in civil defense communications capability. The need for a highly effective system of EOC's has been demonstrated (Ref. 8), and a fully federally funded program for EOC construction could be established by the late 1960's. Should such a program be approved, appreciable numbers of EOC's for state and local governments might be in service by 1975. As a result, it is not unreasonable to expect that full-period and possibly survivable communications would be available between state governments and major local governments whose EOC's are manned full-time during peacetime.

Along with a continuing EBS-type program, the EOC's will have the capability to initiate broadcasts through local broadcast stations, and persons in shelters will be able to receive those transmissions, and, at the minimum, will have telephone communications with their cognizant EOC.

Interface Analysis

An analysis of the possible effects of other civil defense communications systems upon the design of a radio warning system can be divided into two subsections -- national dissemination of warning and local dissemination of warning. Three main possibilities arise when considering the use of other communications systems for warning: (1) their use as the primary means of alert/warning dissemination, (2) their use to provide backup capability for warning dissemination, and (3) their use for verification.

National Dissemination of Warning

The problem of disseminating alert and warning from a national level to regional and state levels of government might be solved by using landline systems, radio systems, or a combination of both. NACOM 1 might be a candidate for a landline system, and NACOM 2 might be a candidate for a radio system. NACOM 2, however, does not appear to be a reliable method for warning dissemination or verification. A study of this system by the Radio Corporation of America has shown that a substantial portion of the system may be severely degraded due to the effects of nuclear explosions upon ionospheric propagation of radio signals. (Ref. 9.)

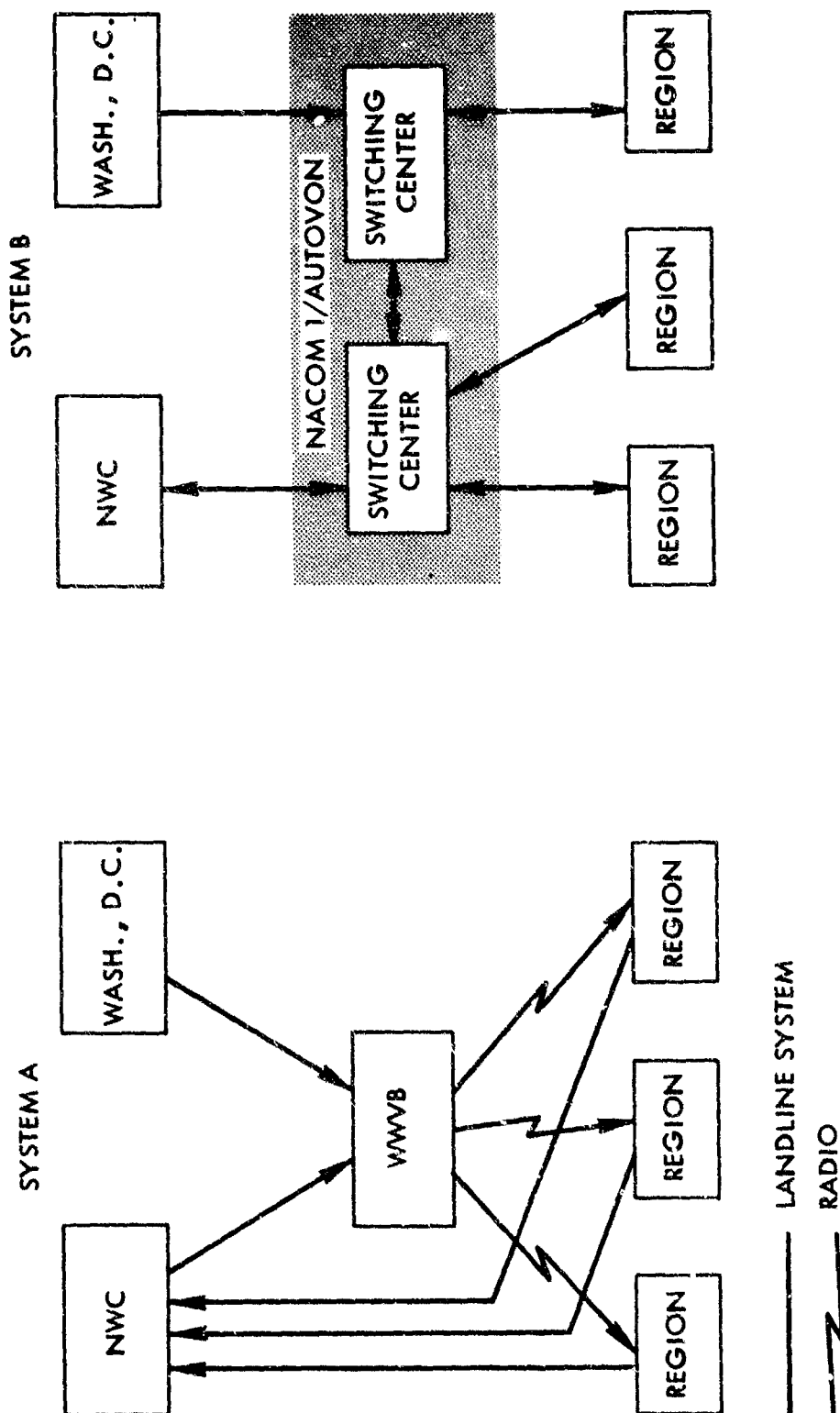
At present, NACOM 1 is connected to the OEP emergency relocation point in the Washington, D. C. area, but is not connected to the National Warning Center (NWC) at Colorado Springs. Furthermore, there are no such plans for connections at the NWC. However, it appears that there would be little difficulty in providing for such connections. There will be a number of AUTOVON circuits installed at the hardened NORAD Combat Operations

Center (COC). To provide a NACOM 1 connection at the NWC, it would only be necessary to arrange for an AUTOVON drop at the NWC, which will be located within the COC.

Depending upon the relative survivability and vulnerability of this system when compared with other possible national dissemination systems, NACOM 1 may have substantial merit. This system has a strong justification for being, in that many types of communications are carried during peacetime and would be carried during transattack and postattack periods. There appears to be no reason why an alerting/warning function could not be added for dissemination to regional or state levels. The amount of time required for alert signals and warning messages would probably be only a small fraction of the total period that circuits are needed for the total civil defense communications, and consequently, little actual message handling capability would be sacrificed for other types of traffic. The relative priority that could be assigned to the alert/warning function apparently would be sufficient to preempt other communications on the AUTOVON system. As a matter of fact, for the periods immediately preceding and following a first strike upon the United States, little demand is foreseen for civil defense traffic other than warning traffic.

The possible use of NACOM 1 AUTOVON facilities for dissemination of alert signals and warning messages can be compared with an alternative radio system using the facilities of the National Bureau of Standards station WWVB. Figure 3 is a schematic block diagram of these two systems. The WWVB alternative, shown as System A in the figure, might be composed of landline links between the warning initiation points and WWVB, radio links to regional headquarters (or regional transmitters if not colocated with headquarters), and verification landline links from the regions to the National Warning Center. The NACOM 1 system, shown as System B, is composed of (1) subscriber lines from each point of interest -- initiating points and regions -- to the AUTOVON switching centers and (2) trunk lines between those centers.

FIGURE 3
COMPARISON OF WWVB AND NACOM 1 COMMUNICATIONS SYSTEMS
AT THE NATIONAL LEVEL



A comparison of the two systems leads to the following conclusions. System A (WWVB) may be superior with respect to vulnerability because it is a radio system, and thus the low-frequency radio links between terminals are not vulnerable to the effects of nuclear attack. Although this conclusion is true in principle, a landline system (even though both the links and nodes are vulnerable) could be relatively invulnerable in practice because of its location, hardness, and/or redundancy. Therefore, the relative vulnerability and survivability of the radio and the landline systems requires further study.

The WWVB system is also superior to the landline system in that other qualified organizations, such as local defense units, military units, or institutions could receive the national alert/warning messages or control signals directly by radio without the necessity of adding a separate landline tie to the warning system for each added unit.

System B (NACOM 1) appears superior with respect to incremental cost, function, security, verification, and interface problems. With the exception of the NWC link to the AUTOVON system, national warning could be carried to regions with an existing (separately justified) system. The postattack needs for NACOM 1 and 2 have justified the costs of the systems. Thus, little incremental cost could be assigned for the use of these systems for the incremental function of warning, even though the peacetime costs for full-period use are appreciable. Only to the extent that additional equipment would be required for the warning function could additional costs be assigned to warning. On the other hand, if regional transmitters were located at some point away from the regional headquarters, additional landline links would be required. System B would be superior with respect to function, in that either live or recorded voice messages could be transmitted nationally, whereas with system A, only code and teletype would be possible. The security of NACOM 1 is higher because it is an off-the-air system; jamming or false alarms could not be accomplished from offshore locations with a clandestine transmitter. The NACOM 1 system

could accomplish verification with the same hardware that would be used for dissemination, whereas the WWVB system would require different circuits for verification and other command-control communications. (Ref. 10, pp. 69, 71, 82-84.) With regard to interface problems, it appears that the NACOM 1 system would be easier to implement and test because it would use full-time circuits already reserved for OCD, which could be preempted for warning, whereas the WWVB system would require interagency coordination.

Many of the features of the two systems would require further study before a decision could be made as to which is superior.

Local Dissemination of Warning

At the local government level, a number of different types of communication offer capability that might be of value in the design of a radio warning system. Of particular importance are communications between AM radio broadcasting stations and the public, and communications between EOC's and AM broadcast transmitters.

It has been shown that there is a need for a local system of communications to the public during transattack and postattack periods. (Ref. 10.) AM radio broadcasting stations offer a significant potential for performing a valuable service of warning--not only for alerting and broadcasting national warning, but also for local communications to the public. Because AM broadcasting capability--both transmitters and receivers--is extensive in peacetime, it is reasonable to suspect that a substantial portion of that capability would survive an attack. Case studies of AM transmitter survivability in a number of metropolitan areas tend to confirm this. (Refs. 11, 12).

After the initial warning and during the transattack period and the post-attack shelter period, persons are likely either (1) to be already listening to their radios* or (2) not be in a position to take any better defensive measures than they already have taken. Thus, during these periods after the initial warning the specific requirement for alerting is not nearly as strong as during the preattack period and after emergence from shelter. The AM stations could pass warning information during the transattack and the postattack shelter periods without modification.

To perform this function, AM stations need information inputs. Two types of inputs can be identified -- (1) those that can be prerecorded for broadcast in event of attack and would be appropriate regardless of the nature and size of the attack and (2) those that cannot be foreseen and depend upon the actual effects of the attack. In the former case, the messages could be recorded ahead of time and held at the broadcast station. In the latter case, however, a capability is required in an EOC to collect and analyze information and to decide upon the messages to be transmitted to the people. To accomplish this, a communications link between the EOC and the AM transmitter is required. Regardless of whether AM stations become a part of the radio warning system, this link is needed before AM stations can be used to transmit local warning messages and instructions.

The importance of AM facilities for warning is underscored by the fact that they can broadcast a message to a large number of persons, i.e., one transmitter reaches many receivers. Other civil defense communications systems do not have this attribute -- they tend to be single transmitter to single receiver in nature. In addition, AM broadcasts can reach listeners regardless of whether they are in public shelter, in private shelter, in transit, etc. Other communications systems tend to be designed for persons in

* At night, persons in shelters could set up a radio watch.

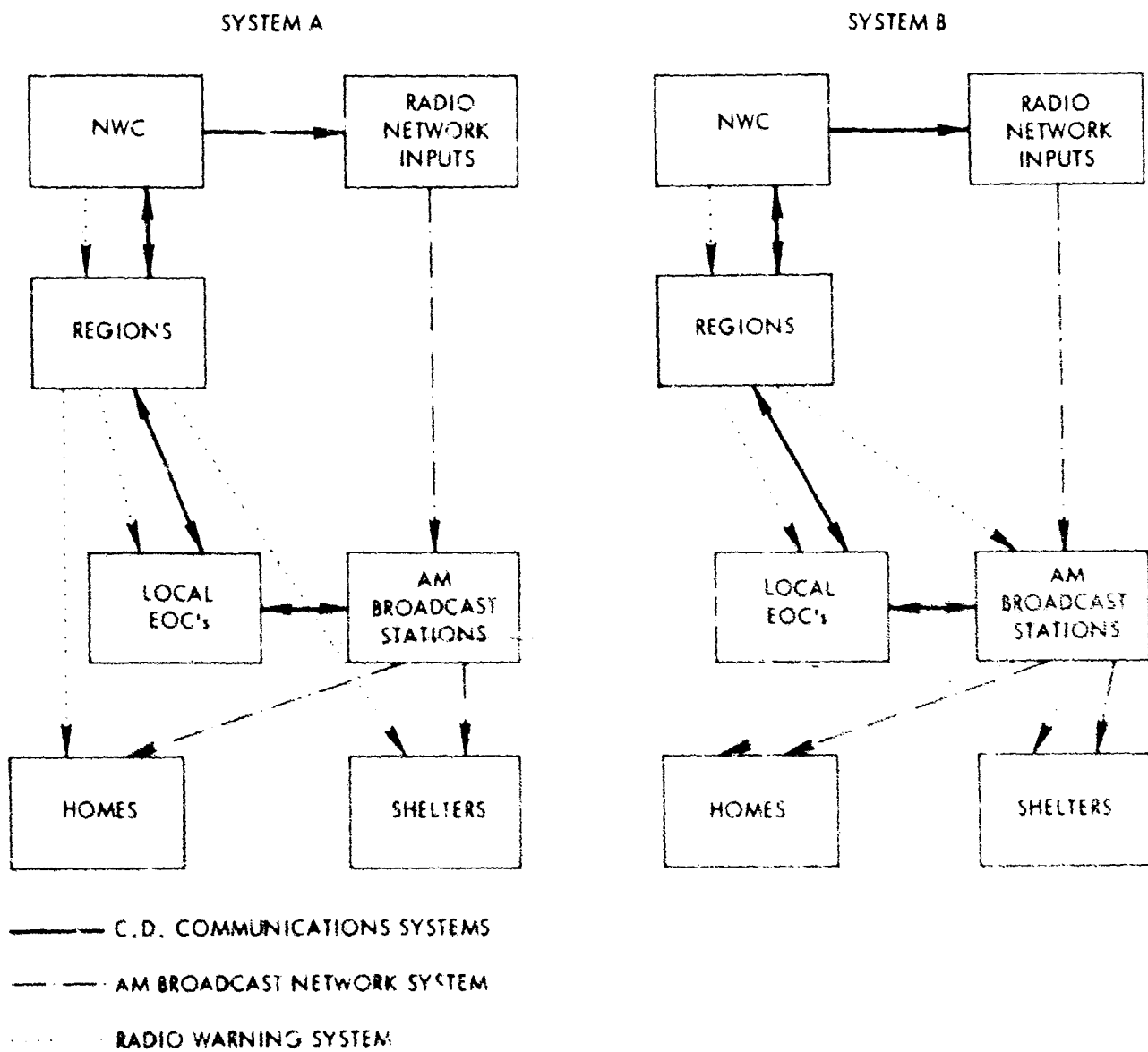
specific situations. One must conclude that, regardless of the state of improvement of other types of civil defense communications, AM broadcasting is a necessary part of the total system for warning and providing information to the public.

To illustrate the effect of other communications systems upon the design of a radio warning system at the local level, consider two warning systems that differ from one another at the local level, in block diagram form in Figure 4. System A is made up of a VLF link between a national warning center and the OCD regions and an LF link between the regions and homes, shelters, and EOC's. System B has a VLF link between the national warning center and the regions, LF links between the regions and the AM broadcast stations and EOC's, and AM broadcast links to homes and shelters. Also shown in the figure are civil defense communications links between the national warning centers and national broadcast inputs, between regional civil defense headquarters and EOC's, and between EOC's and AM broadcast stations. National broadcast network systems are shown between national broadcast inputs and AM broadcast stations and from AM broadcast stations to homes and shelters.

Without considering other types of communications systems, System A appears to have a serious disadvantage in that it cannot transmit local information to the public. However, when the other systems are considered, this disadvantage disappears. In System A, national and regional warning messages are broadcast direct from the regional stations to homes and shelters, whereas local messages are originated at EOC's, transferred to AM broadcast stations, and transmitted to homes and shelters by standard AM transmissions. In System B, the AM broadcast station is the focal point for all messages regardless of their origins. National and regional messages pass from regional transmitters through AM stations to homes and shelters, while local messages originate at EOC's and are passed to the AM broadcast stations to be broadcast to homes and shelters.

FIGURE 4

COMPARISON OF TWO COMMUNICATIONS SYSTEMS
AT THE LOCAL LEVEL



Listed below are some of the advantages that can be associated with each of these two systems.

System A

Better Signal Coverage. It is probable that nearly the entire area of the continental United States could be covered by a small number of LF transmitters presently envisaged as being associated with the eight OCD regions.

Lower System Equipment Cost. Apart from the home receiver, System A would cost less than System B because no warning system equipment would be required in AM broadcast stations.

Faster Response. Because alert signals and warning messages do not pass through AM stations, a more rapid response time should result.

Reduced Dependence on AM Station Survivability.

Redundant Paths for National News. With System A, homes and shelters may receive national news in three ways: through the warning network directly from regional stations, through the warning network to local EOC's and AM stations, and through the AM broadcast network system.

Possibility of a Less Complex Receiver Discriminator. It is possible that the receiver discriminator for an LF system may be no more complex than a simple squelch circuit; further study is needed.

Simultaneous Broadcast. With an LF system it is possible to transmit two broadcasts to the homes simultaneously -- one through the warning system and one through the AM broadcast stations. Thus, local news instructions pertinent only to the specific local situation could be transmitted on one link, while general training instruction for expedient shelter and survival techniques could be passed over the other circuit.

Higher System Reliability. Because there are no broadcast stations facilities in the system, and therefore fewer links and nodes in the network, the overall system reliability should be higher for System A.

Better Receiver Mobility. With System A, a receiver could be moved throughout a region (possibly throughout the United States) without the need for retuning.

Ease of Implementation. System A would be far easier to implement administratively since no approval of broadcasters is necessary.

Ease of Verification. Transmission of warning signals could be more easily verified with System A since only eight signals would be transmitted.

Ease of System Testing. System A would be easier to test since coordination with the broadcast industry would not be required.

System B.

Possibility of Lower Receiver RF Cost. It is possible, but unproven to date, that the RF portion of the home receiver would cost less at medium frequencies than at a low frequency.

Larger Receiver Coverage. With the warning system broadcast to homes on the standard broadcast band, it is possible that the alert/warning function could be incorporated into the design of home entertainment receivers for a low incremental cost. This should induce some persons to acquire the warning capability who would not otherwise do so.

Automatic Coordination. With only a single warning channel, messages passed to the public are automatically coordinated, while with two channels, as in System A, coordination of information would be required to ensure that conflicting information was not transmitted.

Use in Natural Disasters. A bonus value of local alerting for natural disasters is possible with System B, but not with System A.

National Spoofing and Jamming. System B would be less susceptible to national spoofing and jamming because of the larger number of AM stations that would be involved in the system.

Receiver Operability Check. Even though a procedure for allowing receiver operability checks would be required for either system, a major part of the receiver circuitry (all except the muting-demuting circuits) could be checked at any time by listening to normal AM program material.

Impact Warning. With input from local radar sensors, impact alerting and warning could be passed through AM stations to the public in the earliest target areas.

REFERENCES

1. 1963 Annual Report, Department of Defense, Office of Civil Defense, Washington, D.C., 1963.
2. California Disaster Office, Civil Defense Operations Plan, State of California, November 27, 1963. Also discussions with California officials.
3. Civil Defense Operational Plan, County of Santa Clara, California, 1962.
4. Emergency Broadcast System Plan; Federal Communications Commission, Office of Civil Defense, and Office of Emergency Planning; 1964.
5. The Emergency Broadcast System, System Development Corporation, 1964.
6. Bothun, R., and R. Laurino, Radiological Monitoring: Concepts and Systems, Stanford Research Institute, Menlo Park, California, 1963. Also discussions with authors.
7. A Nuclear Detonation Detection and Reporting System Design Study, USAF, Electronic System Division, 1961. SECRET RESTRICTED DATA.
8. The Vital Role of Emergency Operating Centers, Stanford Research Institute staff paper, 1964 (attached to this paper as appendix A).
9. Civil Defense Communications Systems Research, Radio Corporation of America, Defense Electronic Products, Surface Communications Division, March 1963. CONFIDENTIAL.
10. Civil Defense Warning Requirements Study, System Development Corporation, TM(L)-900/001/01, January 31, 1963.
11. "Systems Analysis of Communications," A Survey of the Long-Term Postattack Recovery Capability of CONUS, Annex C, Appendix 4, prepared for Director, Defense Research and Engineering, Stanford Research Institute, September 1963. SECRET
12. The Civil Defense Role of Radio Broadcasting in the Postattack Period, Technical Operations Research, January 1963.
13. AUTOVON Implementation Manual, Defense Communications Agency, November 1964.

VI THE CIVIL DEFENSE WARNING SYSTEM

The Civil Defense Warning System is a special-purpose communications system designed to transmit a warning of attack on the United States to regional civil defense offices, state and local governments, and, via outdoor sirens and loudspeakers, to the general public. Provision is also made to transmit other emergency information between civil defense points. The principal portions of the warning system are the federal portion, the state warning systems, and local warning systems.

Federal Warning System--NAWAS

The federal portion of the civil defense warning system is called NAWAS, an acronym for NATIONAL WARNING System. NAWAS consists of two full-period voice telephone circuits over landlines leased from common carriers. One of the circuits is a warning circuit, the other is a control circuit. (Refs. 1 and 5).

The warning circuit terminates at 89* federal establishments (OCD regional offices, other federal agencies, etc.) and 613* state and local warning points. These state and local warning points are located at state police headquarters, county sheriffs' offices, and similar locations which handle emergency messages as part of their normal function and which are manned 24 hours a day. In addition to these 613 warning points, there are 268* extensions to the warning points, allowing local government officials and others with emergency responsibilities to be warned at the same time as the public. There are also 46* alternate points located in EOC's that have fallout protection, allowing the warning to be disseminated from the EOC in case the EOC is manned due to a crisis or in case warning of a subsequent attack is required.

*As of August 31, 1965.

The warning points within each state are connected through a state warning point. This state warning point has the capability to disconnect the warning points within the state from the national warning system. The state circuit would be disconnected for a roll call of the points within the state following the dissemination of an attack warning. Such a roll call ensures that all warning points within the state have received the warning. Points not responding to the roll call are contacted by long-distance telephone to assure their receipt of the message.

Similarly, the national warning circuit can be broken into three warning areas for roll call and other communications within the areas. A national warning center is associated with each of the three areas. These warning centers are located at the Combat Operations Center at NORAD headquarters in Colorado Springs, Colorado; at the OCD Region V headquarters in Denton, Texas; and in the Washington, D. C., area. (Ref. 2). The warning center at NORAD is expected to be the primary input for attack warning.

The area warning circuits are interconnected to allow the simultaneous transmission of the warning to all warning points, extensions, and alternates. Instructions for interconnecting and communications discipline are handled over the control circuit by the Warning Center at NORAD.

State and Local Warning Systems

Although there are many NAWAS warning points and extensions at local levels, some states operate their own warning systems, using public safety radio, teletype systems, or bell-and-light systems. These state warning systems are used to transmit the warning information, in some cases after an evaluation at the state level, to local communities for further transmission to the public. Flash reports are also transmitted over these state networks.

Local warning systems receive the warning from NAWAS or the state warning network, operate local devices (sirens, horns, loudspeaker systems) to alert the general public, and use telephone or bell-and-light systems to alert local civil defense officials; industrial plants and utilities that require emergency shutdown procedures; and schools, hospitals, and other public institutions. Evaluation of the validity of the warning is frequently introduced at the local level before public alarms are sounded.

Improvements to NAWAS

Two major improvements to NAWAS are indicated -- addition of a hard-copy capability and the use of multiple-tone dialing and switching (Ref. 3, pp. 37, 42). The addition of the teletype capability is intended to eliminate manual copying of messages, slow reading for copying, and numerous repeats and call-backs now being experienced. The multiple-tone signaling capability is intended to increase the flexibility of the system and to speed switching. A test of the multiple-tone signaling was also planned as an activation source for some of the power-line NEAR tests in Michigan.

Improvements in State and Local Warning Systems

State warning networks are presently in various degrees of refinement, and state plans for improvement are not known. The most simple and direct improvement would probably be to eliminate state evaluation and relay of the NAWAS warning, so the warning could pass directly from NWC to all interested local communities.

Improvements planned in local warning distribution systems vary by community and may involve installation of additional fixed sirens or loudspeakers, extension of telephone or bell-and-light systems, the use of mobile

sirens or loud-speakers on police vehicles, and the elimination of local evaluation of the validity of the warning. The cost and effectiveness of these types of improvements have been evaluated in a recent SRI publication. (Ref. 4, pp. VI-11 through VI-21.)

Interface Analysis

Three interface areas have been found in the analysis of the civil defense warning system: (1) interface with the national warning officer at NORAD, (2) interface with the communications links in the system, and (3) interface with the public warning devices at the local level.

Since a system similar to NAWAS will probably be required even with the implementation of a radio warning system, the national warning officer could be required to send out warning messages over up to three warning circuits: the radio warning circuit, NAWAS, and the EAN network, which activates the Emergency Broadcast System. It would be desirable to activate all three warning systems simultaneously rather than to have any one system wait for a sequential activation of the other two. Since all three systems are expected to be teletypewriter systems, consideration should be given to compatible equipment and activating message formats so a single message from a single machine -- or at least from a single operation of the warning officer -- would activate all three systems.

The communications network of the warning system, like other communications systems described in Section V, offers capability as a link in the warning system. Also, NAWAS or some similar warning system may be retained even after implementation of a radio warning system, both as a back-up system and for more specialized warning purposes such as transmission of preparedness states and confirmation messages.

The operation of local public warning devices, such as sirens, horns, loud-speakers, pyrotechnics, etc., by NEAR receivers has been analyzed and found feasible, if the cost of installing the receiver and the necessary switching circuitry can be justified. (Ref. 5, pp. 6-8.) Such an analysis is also applicable to operation of these devices by a radio warning receiver. Furthermore, if power-line NEAR is required in areas where radio signal strength is low or where the power-line system would have a cost advantage, the converters for the power-line system might be actuated by a radio warning receiver.

REFERENCES

1. National Warning System (NAWAS) Operations Manual, Department of Defense, Office of Civil Defense, Manual FG-E-1.2, January 1964.
2. Civil Defense 1965, Department of Defense, Office of Civil Defense, Document MP-30, April 1965.
3. Minutes of the Working Group for Radio Warning, July 6, 1964, Morning Session (Draft).
4. Harker, R. A., R. L. Goen, and K. D. Moll, A Method for Evaluating Local Civil Defense Effectiveness, Stanford Research Institute, October 1964.
5. NEAR System Study, Interim Report to the Office of Civil Defense, System Development Corporation report number TM-L-1505/040/01, March 31, 1964.

VII PUBLIC INFORMATION PROGRAMS

The degree of advance public conditioning for life saving reactions in a nuclear emergency determines, in part, the type of instructions that need to be given the public by radio in the early minutes of an attack. It is therefore of interest to examine the present civil defense public information programs and their effect upon public conditioning or readiness. This section will also attempt to predict the degree of public readiness that will prevail during the 1970-75 period, when the radio warning system will be operational, and to predict whatever new requirements for public information will be generated by the implementation of this system.

Civil defense may be thought of as a set of prepared plans and procedures, facilities, and trained personnel collected and organized in advance to deal with an emergency situation. Considered in this light, the public information program is carried out to (1) provide the general public with a minimum level of preparedness (2) gain public support for the programs, (3) make the public aware of the civil defense effort, and (4) establish contact between the public and the trained personnel who will be directing them during the emergency period.

Program Description

The information disseminated to the public by OCD and by state and local civil defense organizations may be divided conveniently into three categories: (1) technical information on fallout and what to do about it, (2) information about civil defense, and (3) news on the progress of civil defense programs.

Technical Information

A handbook, Fallout Protection: What To Know and Do About Nuclear Attack, was prepared in 1961 and initially distributed through local post offices

and in the Sunday newspaper supplements in 1962 (Ref. 1, pp. 52-56). Since then, additional copies have been made available at local civil defense offices and at the national civil defense headquarters. The handbook is designed to present an average reader with essential facts about fallout and what can be done to avoid its effects. The primary purpose of the handbook was to convince the public that lives could be saved by fallout shelter. By mid-1963, more than 41 million copies had been distributed.

Another publication, on family shelter design, has been distributed on a similar basis. Several pamphlets on fallout protection for agriculture have been distributed through agricultural extension agents and 4-H clubs. Information on fallout effects and shelters is also presented in movies, which are available on loan from Army film and equipment exchanges, and in mobile exhibits of fallout shelter designs. (Ref. 2, pp. 89-92.)

Information about Civil Defense

Information about civil defense includes descriptions of the fallout shelter program, fallout shelter signs, stocking fallout shelters, warning signals, and reminders of the existence of civil defense. Exhibits, posters, spot radio and TV announcements, radio programs, and articles for newspapers and magazines are used as channels. An information packet has also been prepared and distributed through national organizations. (Ref. 2, p. 92.) As communities mark and stock more shelter spaces, some will begin to prepare community shelter assignment plans. Information on the assignment plans will be described in pamphlets distributed by civil defense workers or volunteers and in local newspapers. (Ref. 3, p. 3.)

News on the Progress of Civil Defense

To keep the public informed on shelter program progress, local and national progress reports are issued through news releases.

Effect of Civil Defense Information on Public Attitudes

Civil defense information is directed toward providing factual technical information and news to the public. The technical information is made available for those who are interested enough to request it. Little effort is made to promote civil defense in the way that soap, cigarettes, etc. are sold.

The result of this approach is a general awareness of civil defense, but a lack of specific knowledge about what to do. Several factors point to a possible improvement in public attitude and knowledge. First, the fallout shelter program may be seen as a step toward positive action, after many years of inaction and dispute. Second, the large number of fallout shelter signs and related information that are being distributed will tend to keep the public aware of civil defense. Finally, public interest in civil defense tends to rise during periods of international crisis. Each crisis -- Berlin Wall, Cuba, etc. -- has brought large numbers of requests for civil defense publications. The cumulative effect of these recurring crises will be a greater quantity of information in the hands of the public. (Ref. 4.)

Interface Analysis

Even with these improvements in public attitudes and knowledge, an informed and trained population cannot be assumed in the design of a radio warning system. This conclusion strengthens conclusions already reached -- information and instruction on what to do and how to do it must be broadcast at the time of the attack, and the detail required in this instruction must be originated at the local level.

The implementation of a radio warning system will require the dissemination of additional information to the public. First, the receivers must be placed in the hands of the public, and current public attitudes may need to be assayed in determining favorable procedures for distributing them. It is too early in the development program to pursue this point further, but it must certainly be

analyzed in detail in later implementation studies. Second, some action on the part of the public will be required to use and test the public receiver. This analysis suggests that operation and testing be simple and require minimal effort on the part of the public.

REFERENCES

1. National Fallout Shelter Program, Sixteenth Report by the Committee on Government Operations, U. S. Congress, House of Representatives, Report No. 1754, May 1962.
2. 1963 Annual Report, Department of Defense, Office of Civil Defense.
3. Shelter Surveys, Federal Guidance for State and Local Civil Defense, Federal Civil Defense Guide, Part C. Chapter 2.
4. Garrett, R. L. , Summary of Studies of Public Research Directorate, Office of Civil Defense.

Appendix A

**THE VITAL ROLE OF EMERGENCY OPERATING CENTERS
IN COMMUNITY SURVIVAL**

Appendix A

THE VITAL ROLE OF EMERGENCY OPERATING CENTERS IN COMMUNITY SURVIVAL.*

An Emergency Operating Center is a structure designed to provide the protection and facilities essential to centralized direction and control of survival and recovery activity in a community experiencing effects of a thermonuclear attack.

The need for an EOC is therefore linked to the requirement for centralized direction and control. This need can best be established by considering jointly the alternative configuration of emergency government, namely decentralized direction and control, as posed by the following inquiry:

"Can the various departments of local government, operating independently or through radio and telephone linkages, carry out the vital functions required in a nuclear disaster without centralized direction and control?"

The remainder of this paper is largely dedicated to demonstrating why a totally decentralized concept of operation would fail to meet the vital needs of the community under the extreme conditions that would be encountered.

Radioactive fallout, heavy blast damage, and conflagrations will present conditions not encountered in normal operations or civil disasters. In this environment, with the population housed in community and private shelters, problems will be generated that cannot be handled effectively by the various departments of local government, acting without centralized direction and control. The following points support this assertion:

*This paper was prepared by A. A. McGee and V. L. Preisser as one task under OCD contract No. OCD-OS-63-149, for planning and operations analyses of emergency operating centers.

1. Legal Responsibility and Prerogative

Decisions concerning the allocation of community resources must be made by government officials vested with authority to span lower level jurisdictional lines. The gravity of decisions included in the commandeering of private property, seizure of warehouse stocks, transferral of people between shelters, and solicitation of aid from adjacent communities can only be made by the chief executives of the community. A central grouping of such key officials is deemed essential to full consideration of the legal and jurisdictional questions that major decisions will raise.

2. Unfamiliar Operations -- Special Skills

The range of problems characteristic of a nuclear attack will vary widely from peacetime disaster experience. The specialized knowledge required for the solution of unfamiliar problems will be distributed among a small number of individuals within the community. It would be inefficient to isolate such persons where their talents would not be available to the entire community. (The implication here is that of not having enough specialists for each decentralized control point.) The merits of centralizing the community's critical human resources are obvious. Also present is the need for legal sanction where decisions concerning unfamiliar operations lack precedent.

3. Limited Resources -- Overwhelming Demands

In contrast to normal operations, the number and magnitude of emergencies will exceed the resources available to counter them. It is vital that these limited resources be applied where they will be most effective in saving lives and property. The excess of demands beyond available resources would lead to dissipation if allocation by a completely decentralized system. Knowledge of the entire community situation is required prior to making decisions concerning the distribution of

resources. In fulfilling multiple requests for limited resources, a priority system must be used. Decisions on priority assignments relate a knowledge of the overall situation with the potential outcomes under various allocation rules. Such rules may change over time. The elements of change, assignment of priorities, limited resources, and the need for wide knowledge combine to add a strong argument in favor of a measure of centralization.

4. Civil Disaster Experience

The value of EOC's in peacetime disasters should not be overlooked. Their utility was recently demonstrated in the Alaskan earthquake where central direction of rescue and recovery operations was conducted from an EOC. Unfortunately, the value of EOC's in natural disasters is better demonstrated by observing instances where central control was lacking and chaos resulted. Such examples include the Worcester, Massachusetts, tornado and the Indianapolis coliseum disaster where casualties were rushed in overwhelming numbers to one or two hospitals while many nearby hospitals received few patients; the Yuba City, California, flood where the city council became aware of a break in the levee only when water reached the city hall as it flooded the city and drowned 34 persons. This gross incompetence was caused by poor communications organization and the lack of a qualified analyst to interpret the information that was received. There are numerous instances such as the Beecher tornado where the lack of coordination of rescue activity carried on by city and state departments and volunteer groups resulted in mass confusion at the site of the disaster. These instances all indicate the need for a central control point which ensures that gaps and duplications in the exercise of authority do not exist.

5. Central "Clearing House" -- Marshaling Resources

One "clearing house" must be established for requesting and coordinating assistance between shelter complex headquarters, with adjacent communities, with higher levels of government, and with nearby military installations. Permitting each of the various city departments to attempt individual liaison with all other departments would result in confusion, delay, excessive communication equipment costs, and debate concerning who has preemptive control at any point in time. Marshaling the resources of the community requires the crossing of conventional boundaries on jurisdiction, ownership, and civil usage. Experience has continually demonstrated that an absence of any clearing house for aid requests or public information creates serious imbalances in the recovery effort. Duplications of requests, absence of definitive action, uncertainty as to who is controlling resources, and a continuing "feast or famine" situation for some sectors in the community are historically documented. Compound civil disasters with the presence of fallout and the disruption of entire social systems and one can only guess at the consequences emerging from a disaster plan lacking central control and coordination.

6. Recovery -- Planning and Execution

Based upon data collected on surviving community resources, government officials must plan and organize for the recovery period. Centralization of key officials, along with the information essential for formulation of a recovery plan will minimize the confusion as the population emerges from shelter. Failure to centralize such recovery planning for the community would create an incoherent and undisciplined set of conflicting desires, even within a shelter complex headquarters, giving those persons emerging first from shelter preferential access to surviving resources. Careful estimation of minimal community

needs will allow increased aid to less fortunate nearby communities. Such examples point out that a necessary element in recovery planning is a centralized body to collect, sort, and analyze information for the entire community.

The existence of direction and control systems at the local level, of which the EOC is an essential element, would ease the burden at higher levels of government in the event of a nuclear disaster. If large numbers of communities are unprepared to cope with the problems cited above, the amount of federal and state involvement in local survival efforts will be unlimited. If, however, a realistic system of self-help and mutual assistance is developed through properly linked EOC's, the state and federal governments can concentrate their resources on those communities which are overwhelmed in spite of well-prepared disaster organizations.

The implication should not be drawn from this paper that an EOC in a community makes possible a totally centralized control system. On the contrary, an austere system is advocated to preclude this impression. EOC's, with limited space will force the decentralization of many control functions to lower elements of emergency government (such as shelter complex headquarters). The illusion must be dispelled that all problems will be solved within a "wonder building" outfitted with elaborate displays and equipment. Enforcement of reasonable decentralization will result in a more realistic and flexible operational plan while automatically building redundancy into the system.

Appendix B

ANTIBALLISTIC MISSILE PROGRAMS

(Classified supplement bound under separate cover.)